



A National Science Foundation
Project by Old Colorado City
Communications

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FEDERAL COMMUNICATIONS COMMISSION

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Dave Hughes
Principal Investigator
dave@oldcolo.com

Dewayne Hendricks
CO-PI
dewayne@warpspeed.com

CO-PI

Dr. George Johnston
CO-PI
glj@zone.ultranet.com

L.S. Fox
Administrator
larry@oldcolo.com

In the Matter of

COMMON CARRIER BUREAU SEEKS FURTHER
COMMENT ON SPECIFIC QUESTIONS IN
UNIVERSAL SERVICE NOTICE OF
PROPOSED RULEMAKING

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CC Docket No. 96-45

COMMENTS OF THE NATIONAL SCIENCE FOUNDATION
WIRELESS FIELD TEST FOR EDUCATION PROJECT

Summary of our comments:

Question 7 - yes, internal connections of both wired and wireless devices should be eligible for universal service support. No-licence wireless communications costs are entirely in the cost of the devices - there is no 'service' cost, while the savings in total cost can be very substantial over common carrier data services.

Question 15 - State Departments of Education should be recruited, after being trained, to advise school administrations on the criteria for bona-fide requests. A spread-sheet model for making cost analyses of communications alternatives should be developed to aid administrators in evaluating both comparative and absolute costs.

Question 23 - The McKinsey study is very flawed and incomplete in its evaluation of the potential and cost effectiveness of wireless communications - particularly of longer range, between building, communications at high data rates.

Question 59 - costs of connectivity of satellite, microwave, trunk, and all other forms of wireless connectivity should be included in the BCM. However common carriers should be prevented from levying unwarranted 'interconnect' charges.

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FULL DISCUSSION

QUESTION 7

7. Does Section 254(h) contemplate that inside wiring or other internal connections to classrooms may be eligible for universal service support of telecommunications services provided to schools and libraries? If so, what is the estimated cost of the inside wiring and other internal connections?

Whether a narrow legal interpretation of that section specifically contemplates that 'inside wiring or other connections' is eligible for universal service support funds or not, since the ultimate purpose and goal of the service is to insure and subsidize what it takes to extend telecommunications services to schools and libraries then the Section 254(h) should be so interpreted as permitting that eligibility.

The reason is that no-licence wireless communications - which generally do not involve commercial communications 'services' - are a major, and growing, way to reduce the ultimate cost of data connectivity to and within schools and libraries. Commercial wireless services are not the only way schools can or should be connected. In fact a case can be made that no-licence, non-commercial wireless, both under current FCC rules, and pending rules - such as the NII/Supernet Proposed services - are more appropriate and cost-effective for distribution of data within, between, and outside the 84,175 public schools, 16,438 school districts, and 15,679 public libraries, than any commercial wireless service available today or for the foreseeable future.

No-licence wireless should be considered among these 'other connections' in which the only cost are the radios and associated connectivity devices themselves - including antennas, cabling, radios and associated routers, and technical installation. Such devices are the means by which internal (to single buildings or between close buildings) connections, connections between the buildings of a school district, or branch libraries in a community, and even connections to the nearest Internet point of presence can be implemented at the high data rates required for institutional connectivity (from 56kbs to 2Mbps - or above T-1 right now with off the shelf Part 15 FCC radios), at zero connectivity cost for that link.

The savings in local costs can be, over time, enormous. Specific wireless for education projects we have studied as part of our NSF Wireless Field Tests, or are engaged in installing and testing, demonstrate savings such as the following example:

The 10 year (two 5 year common carrier contract periods) cost of US West T-1 services between 14 school rural school districts of the San Luis Valley of Colorado, and the Alamosa point of presence has been quoted by US West to Trinidad Junior College of Alamosa at \$1.2 million. or over \$9,000 per month. The total cost to link the same districts by off the shelf Solectek 2Mbs, 25 mile range, radios, including routers, for the same 10 year period is \$134,000.

In school complexes where 'wiring' is prohibitively expensive, for reasons of asbestos, construction costs, or buildings not originally designed to be connected, short range wireless LANS can result in some savings. However it must be pointed out that there are no-communications-cost wired solutions also. Wireless PCMCIA cards installed in free standing computers linked to a Wireless Lan Base stations which itself is connected into wired LANS, cost in the \$500 to \$1,500 range. Wired LANS are cheaper PROVIDED there is no serious through-the-walls construction costs.

Using the universal service support fund to purchase and install such standard, off the shelf, digital radios, wireless LANS, and associated antennas and cabling is the only sensible way to get, in thousands of cases, the highest level of connectivity at the lowest cost and demand on the service funds. It would be penny wise and pound foolish to fund only commercial data communications services, and thus incur recurring costs to the end of time, where one time equipment costs are all that is necessary.

QUESTION 15

15. What is the least administratively burdensome requirement that could be used to ensure that requests for supported telecommunications services are bona fide requests within the intent of section 254(h)?

There are a number of ways to reach the Administration of all schools in the country. The State Departments of Education should be recruited to assist in the interpretation of criteria for awards. At least one staff member of each should be trained in the rules. And in most states, the State Librarian, could perform a corresponding service. Obviously a layman language booklet needs to be written by professionals in communicating complex rules, which can be distributed to school and library districts, and be on demand at the Government Printing office - besides the obvious laying out of the same criteria on an FCC web site - but with interactive Q&A features to permit, by answering a series of questions yes or no, to sort through eligibility.

It is quite possible to develop some straightforward mathematical formulas for entering fixed and continuing costs of various connectivity solutions, and getting comparative costs - in the case of digital services normalized to bandwidths, i.e. 56kbs, 256, 512, 1024 or 1.544mbps T-1 that the institution needs.

For example, in our NSF tests of wireless for schools, we have constructed a formula and spread sheet into which can be entered variables for each typical level of bandwidth desired, such as fixed equipment costs (DSU/CSU, Routers for local loop service, radios, antennas and peripherals for wireless), rated equipment life in years, installation costs, routine maintenance costs, either factors or contracts, monthly fixed or variable service cost, (zero for wireless while \$xxx for loop providers such as \$650/mo T-1) , for the minimum contract periods, in months, the total real costs to

the institution over time.

In this way we have been able readily to see, and analyze the comparative cost effectiveness for any local situation and mix of wired, cable, no-licence, or licenced commercial wireless. The key is that institutions such as schools or libraries can judge what bandwidth they need, now and in the near future, (56kbs is quite sufficient now, for small schools, or schools with only small number of workstations, and many rural schools, but T-1 is needed for large, and many urban schools or districts).

The development of such spread sheet models, with explanatory documentation (definition of cell meanings) distributed by disk, ftp, or web download, for the use by institutions could quickly permit the management of such organizations to compare costs, and see what is, or is not, 'affordable.'

QUESTION 23

23. Are the cost estimates contained in the McKinsey Report and NII KickStart Initiative an accurate funding estimate for the discount provisions for schools and libraries, assuming that tariffed rates are used as the base prices?

We, (NSF project) find serious shortcomings in the McKinsey & Company Report's analysis of the utility of digital wireless for education, and consequently, except for its analyses of school wireless LANS, very misleading with respect to comparative costs.

At the base, it did not properly give weight to one of the most difficult costs to meet for a school district with more than one building complex - the cost of bandwidth between the buildings of a district over ground not owned or controlled in right-a-way by the school. In a typical case of School District 11 of Colorado Springs, with 55 separate buildings out to 7 miles distance from the District Headquarters, which is the central point of presence for Internet connectivity, their desired T-1 links between all the buildings of the district, will cost approximately \$12,000 a month from US West plus the one time costs of T-1 capable DSU/CSUs and Routers. Over 10 years those costs exceed \$1.4 million. While, at a current market price cost for T-1 digital wireless systems, of less than \$400,000 for the first 10 year, and none thereafter, the same district can be fully connected.

In another case, the Belen School District of Belen, New Mexico, a town with 8 schools, is avoiding US West costs of \$84,000 a year by using Solectek 2Mbs, 3 mile range radios in a network so fast it operates as a district-wide LAN.

Since most public K-12 schools in the US operate only on a 9 month school-use year, while dedicated data services routinely require 3 to 5 year contracts which assume continuous use, there is, in effect, an 25% cost-penalty for using commercial wireline services during periods it cannot be used, but must be paid for as a service.

Whether the alternative is no-licence wireless, or any other solution, we find that the stiffest, and least affordable cost, is the linking of the schools of a district to each other. This is

true in both rural schools districts of 1,000 students or more, as it is for urban schools. The no licence wireless solution is very appropriate for this cost area, particularly in light of the fact that most school district boundaries correspond with the populated community boundaries - thus do not involve long range (over 20 miles) distances, which readily can be bridged with current radios, even under Part 15 regulations limiting their power to 1 watt.

The issue of 'between buildings' connectivity, within buildings, and between schools and a point of presence, has to be analysed seperately. The study seemed utterly to overlook that 'between building' cost problem entirely.

The study also did not address the future problem (higher connectivity than POTS lines which can handle only about 28.8kps) of connectivity between teachers and their school, and students and their school/libraries nights and weekends when individual preparation and study peaks. 28.8kbs is already proving insufficient for serious educational multi-media work. Purchasing dedicated, or ISDN links for such individual home study purposes is too costly. Wireless links to schools as far as 20 miles away, at data rates of 115kbs can be done today with radios costing in the \$1,500 range, with no monthly recurring charges, while common carriers have pending requests to many PUC' for ISDN rates up to \$180 a month, plus the approximately \$500 cost for the ISDN devices required to connect them to individual computers. ISDN type 'last mile' connectivity is no answer to home connectivity. Wireless can be.

We think the following statement from the McKinsey Report is wrong. "[t]he models focus on networked computers linked together and to the NII via wireline connections, except in rural locations where wireless connections are more feasible." (p.19). In fact urban connectivity - because of range/bandwidth tradeoffs may even be more cost-effective, and 'feasible' than rural, where, partly because of FCC range-limiting rules for radiated power, the cost in radios to get range can get relatively high.

The report also states that "[f]ixed wireless solutions have a number of limitations, particularly in urban or suburban environments: a clear line of sight is required, reliability can be low, only data and digitized video can be transmitted, and there is a potential for clogging the bandwidth as more and more users seek to utilize wireless communications."

Of all the limitations McKinsey cites, only the 'line of sight' characteristic of current generations of radios operating in frequencies assigned by the FCC is a major consideration - and the ability for common products to 'relay' signals over or around obstacles is well known. How direct a sight line required is a function of frequency, a regulatory matter. Reliability can be quite high, and in fact, when compared with Microwave which is affected by weather, spread sprectrum technologies are extremely reliable.

It is simply not true that only data and digitized video can be transmitted by wireless. 64kbs of bandwidth can carry natural voice, while 25 mile range, 2Mbps (above T-1) digital radios are available from several vendors, and Internet phone communications is already widely available - with large companies such as IBM and Microsoft selling software for it.

Full teleconferencing - voice, image, text, white boarding - using such low cost softwares as CuSeeMe operating on individual Windows equipped PCs or MacIntoshes is wholly feasible with high bandwidth wireless.

The reference to 'potential for clogging bandwidth' betrays a failure to understand the technological merits of 'spread-spectrum' radio and the revolutionary impact of 'processing gain' on permitting very large numbers of radios to operate securely with high bandwidth in the same electromagnetic space. The most recent doctorate work at MIT ("Decentralized Channel Management in Scalable Multihop Spread-Spectrum Packet Radio Networks" Shepard, July 1995), demonstrates that interference can "remain manageable even as the system scales to billions of nodes", with computer simulations of one thousand radios in the same local area confirming the calculations.

In short the authors of this study demonstrate little expertise in evaluating the potential of longer range digital wireless, which is undergoing - due to the explosive growth of digital signal processing power, a far more significant revolution of higher bandwidth, longer range at decreasing levels of power, greater co-existence with other signals than is generally understood. And a growing number of companies are entering the market for such capabilities, as rulemaking by the FCC makes it even more feasible, and economic.

It is expected within 24 months, through radio-board developments being funded by the National Science Foundation, for incorporation into commercial radios, that devices costing under \$500, with no-licence shared-spectrum bandwidth of T-1 speeds, in ranges from 1 km potentially to 200 kms, will be in production. See <http://wireless.oldcolo.com> for additional references.

Regulation, not technology or economics, are the only bars to extending affordable 'universal service' to every habitation in the United States.

QUESTION 59

59. The Maine PUC and several other State commissions proposed inclusion in the BCM of the costs of connecting exchanges to the public switched network through the use of microwave, trunk, or satellite technologies. Those commenters also proposed the use an additional extra-high-cost variable for remote areas not accessible by road. What is the feasibility and the advisability of incorporating these changes into the BCM?

It is entirely appropriate to incorporate into the BCM the costs of inteconnecting microwave, trunk, or satellite technologies, as well as all other forms of wireless technology - such as T-1 no-licence wireless devices, which can be channelized for communications services the same way common carrier services can.

But we recommend that common carriers not be allowed to impose special charges, without full cost-justification, for the connection of no-licence wireless communications to their networks, simply because they are wireless, and do not constitute tariffed

services. This practice has begun to occur, and is anti-competitive, as well as being unjustified in terms of real costs to the common carrier. A no-licence wireless T-1 data link connected to a common carrier's fiber T-1 service is no different than connecting a fiber T-1 to the service.



David R Hughes

Principal Investigator

NSF Wireless Field Tests for Education Project.

2502 W Colorado Ave #204

Colorado Springs, CO

80904

dave@oldcolo.com

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